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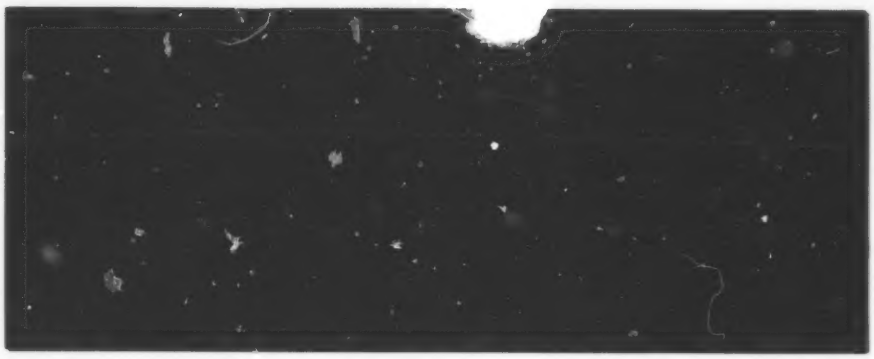

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EAST CENTRAL SASKATCHEWAN

SOIL CONSERVATION PROJECT

FINAL REPORT

1986-1990

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Final Report

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East Central Saskatchewan
Soil Conservation Project

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FOREWORD

The East Central Saskatchewan Soil Conservation Project was initially approved as a three year research and demonstration project, scheduled to conclude in March, 1989. However, due to the interesting trends in the results and the support and interest among farmers and industry groups, the project was granted a one year extension. The additional year of data collection has helped to reinforce the previous findings and give us more insight into conservation tillage.

The extension of this project would not have been possible without the continued support from the province of Saskatchewan's **Agriculture Development Fund** (funded through the Economic and Regional Development Agreement (ERDA), **Hoechst Canada Inc., Agriculture Division**, and **Agriculture Canada at Indian Head**. The extension of this project has also allowed the steering committee to be instrumental in organizing the "Crop Management for Conservation" symposium held in Yorkton on February 22 and 23, 1990. A detailed summary of conservation tillage research results from Western Canada was published in the form of a proceedings. These proceedings were made available to the participants at the symposium and other interested groups and individuals.

ACKNOWLEDGEMENT

The East Central Saskatchewan Soil Conservation Project would like to thank the members of the steering committee for their efforts, interest and dedication to this soil conservation project. Special mention is given to Hoechst Canada Inc., Agriculture Division for their financial support and for administering this project. A special thanks to Saskatchewan Agriculture and Food in Yorkton and Regina for their continued support and to the research and technical staff of the Indian Head Experimental Farm and to research staff of the Regina Research Station.

A very special thanks is given to all the co-operators involved in the research and demonstration components of this project. It is their co-operation that has allowed us to collect valuable research information from their farm. The inconvenience that the co-operators have had to tolerate by having research plots on their land was greatly appreciated. A special thanks is also extended to numerous agricultural companies for supplying equipment and products for use on this project.

G. P. L.

RESEARCH SITES

1.0 INTRODUCTION

The basis for this project was to study cropping practices that would alleviate the problems with soil erosion and degradation associated with excessive tillage and summerfallow practices. The project has made use of research and demonstration trials to investigate these cropping practices.

The research component studied the profitability of extended crop rotations to alleviate the need for summerfallowing and as well, studied the value of reduced or conservation tillage. The demonstration component involved the development of demonstration projects that would address some aspect of soil conservation (eg. chemical fallow, straw and chaff management, minimum tillage seeding practices, comparison of different conservation tillage seeding implements, different seeding systems, minimum till fallow, etc.). A demonstration project was initiated in each of the eight agricultural extension districts that make up East Central Saskatchewan.

The project was made possible through the co-ordinated efforts of Saskatchewan Agriculture and Food, Hoechst Canada Inc., Agriculture Division, and Agriculture Canada at Indian Head. The major portion of the funding for this project was provided by Saskatchewan's Agriculture Development fund. The remainder of the funding was provided by Hoechst Canada Inc., Agriculture Division.

The purpose of this report is to highlight the results obtained with this project as well as provide some general conclusions. Since detailed summaries of the results have already been given in the annual reports (see Annual Reports for 1986, 1987, 1988 and 1989), only brief summaries of the results will be presented in this report. The report will discuss the research and demonstration component separately.

2.0 THE NEED FOR NEW CROP PRODUCTION PRACTICES: A CASE FOR CONSERVATION TILLAGE.

Researchers and producers are presently faced with important challenges for the next decade:

1) *Soil erosion is causing significant losses in organic matter.*

2) *Drifting soil represents a major source of pollution, especially when that soil ends up in streams, rivers and lakes. This soil is very rich in nutrients and can lead to eutrophication.*

3) *Unnecessary tillage leads to the unnecessary burning of fossil fuels which also represents a source of pollution.*

Organic matter is the key to the long term productivity of soils in Western Canada. Organic matter is important because it:

1) acts as a glue to hold soil particles together giving the soil structure through aggregation.

2) represents a rich source of nitrogen, phosphorus, potassium and sulfur.

3) is important for cation exchange capacity.

4) increases the water holding capacity of the soil.

Another important fact to remember is that water is still one of the most limiting factors to crop production in Western Canada. The 1988 crop year will attest to that.

A close examination of average growing season precipitation (P) and potential evapotranspiration (ET) for various locations in Western Canada (Table 2.1) reveals that in all cases, potential evapotranspiration exceeds precipitation. The ratio ET/P varies from 1.7 at Vegreville to 5.6 at Swift Current. Consequently, water deficits are experienced practically every year by crops regardless of location. The magnitude of this deficit varies with location.

Table 2.1 Average growing season precipitation and potential evapotranspiration for different locations in Western Canada (May 1-Aug. 31)

Location	Precipitation inches	Potential Evapotranspiration (ET) inches	ET/P
Swift Current SK	6.9	39	5.6
Indian Head SK	8.8	34	3.8
Yorkton SK	9.2	33	3.6
Melfort SK	9.0	16.1	1.8
Vegreville AB	9.9	16.9	1.7
Brandon MB	10.8	19.3	1.8

Evapotranspiration (ET) is made up of two components (ET=E + T). The first component (E) represents that portion of water evaporated at the soil surface. The second component (T) represents that portion of water transported through the plant and evaporated at the leaf surface.

There is a direct relationship between yield and transpiration (T). Consequently by increasing transpiration, yields should also increase. However, crops experience moisture deficits practically every growing season and the only way to increase transpiration without running out of water would be to supply water in the form of irrigation, but this is not practical for the most part. The other way is to reduce evaporation (E) thereby making more water available for transpiration (T). It has been calculated that 5-40% of water available for plant growth can be lost through E. The strategy then becomes to try and manipulate the crop environment in such a way that E can be decreased.

Evaporation of water at the soil surface occurs in three stages. The first stage is very rapid and is a function of the net transmission of water to the soil surface and the environmental conditions above the soil surface. The second stage is slower and is controlled by soil factors. The third stage is very slow and is controlled by soil factors at the liquid-solid interface.

When PFRA was established in the thirties, the first objective was to provide solutions to the pressing problems of erosion. Their research resulted in five general recommendations:

1) *Reclaimation*
2) *Strip cropping*
3) *Trash management*
4) *Extended cropping*
5) *Shelterbelts*

Of the five recommendations put forth, trash management was the one that offered the most promise. Therefore the obvious strategy to adopt to reduce evaporation (E) is by making better use of straw and standing stubble. Surface residues will reduce evaporation and will also protect the soil against wind and water erosion. By making one change in the production practices through the maintenance of surface residues and standing stubble, the risks of erosion have been decreased substantially and the potential for higher yields has been increased.

Surface residue and standing stubble are very important and are the cornerstone to sound conservation practices because they provide for:

1) erosion control
2) water conservation
3) improved infiltration during heavy rainfall events
4) reduction in soil water loss through evaporation.

The challenge faced by agronomists is to develop crop production systems that will make full use of the potential that trash and standing stubble have to offer. This will be done through the research and promotion of reduced tillage and direct seeding systems or more commonly referred to as conservation tillage systems.

There exists a lot of information on the benefits of straw and standing stubble and these benefits can be expressed under both dry and humid environments. However, these benefits will be expressed differently depending on the environmental conditions encountered. It has also been found that surface conditions have a greater effect on infiltration than soil type, slope, previous water content and rainfall intensity. Reduced wind speed at the soil surface due to surface residues is a major factor in reducing evaporation, especially

in a dry environment. Standing stubble is four times more effective as flat lain residues for controlling wind erosion. This fact is crucial in years of low residue production because maintaining standing stubble until seeding is complete is critical to protecting fields against wind erosion.

The minimum amount of residue required on the soil surface to protect against wind erosion varies with soil type. The minimum amounts required for a medium loam soil, fine clay soil and a coarse sandy soil are 900, 1350 and 2000 lbs/acre, respectively or correspondingly, the equivalent of a 10, 15 or 22 bus/acre spring wheat crop. In order to illustrate how easy it is to be below the threshold value for protection against wind erosion, a conventional and a conservation tillage scenario is discussed. Table 2.2 gives an example of the effects of a conventional tillage system on residue conservation under three levels of residue. In two of the three residue levels presented, the amount of residue remaining after the seeding operation was complete, was below the threshold value.

Table 2.2 The effects of a conventional tillage system on residue conservation for three levels of residues.

	Previous Spring Wheat Crop (bus/acre)		
	15	30	45
Residue produced (lbs/acre)	*1350	2700	4050
1 Fall Heavy duty cultivator operation (20% reduction)	1080	2160	3240
1 preseeding cultivator operation + harrow (40% reduction)	648	1296	1944
Seeding operation Double disc drill	648	1296	1944
Hoe drill (10% reduction)	583	1166	1750

Table 2.3 gives an example of the effects of a conservation tillage system on residue conservation for the same three residue

levels. In that scenario, only the lowest initial residue level gave residue levels below the threshold value when seeding was complete.

Table 2.3 The effects of a conservation tillage system on residue conservation for three levels of residues.

	Previous Spring Wheat Crop (bus/acre)		
	15	30	45
Residue produced (lbs/acre)	*1350	2700	4050
Direct seeding with airseeder using heavy duty cultivator with wide sweeps followed by 1 harrow packing (40% reduction in residue)	810	1620	2430

Conservation tillage implies farming with straw. The key factor to remember is the amount of surface residues remaining after seeding is complete. A 30% ground cover is required to protect fields against wind erosion and this is approximately 1350 lbs/acre or the equivalent of the residue produced from a 15 bus/acre spring wheat crop. Consequently, in years of low crop production, the use of direct seeding to maintain standing stubble may be required to ensure protection against wind erosion. As well, the benefits that can be obtained with surface residues and standing stubble may not materialize if the residue levels produced the previous year are low.

Successful conservation tillage practices hinge on five major factors:

1) *Equipment available*

2) *Crop management*

3) *Surface residue conservation*

4) *Weed control*

5) *Management skills and forward planning*

3.0 RESEARCH RESULTS

As mentioned earlier, the basis for the research component of the East Central Saskatchewan Soil Conservation Project was to investigate innovative crop production systems that addressed soil conservation issues. The systems include different tillage practices and extended cropping rotations. The whole idea revolves around the concept that minimal soil disturbance leads to improved trash cover which implies less chance for soil erosion and as well, increased moisture conservation. Moisture conservation should lead to more water available for crop growth which should lead to better yields and better yields should mean higher net returns. An attempt was made to investigate these concepts at various locations in East Central Saskatchewan, namely Tadmore, Ebenezer, Waldron and Ituna with the respective soil types, Meota fine sandy loam, Canora light loam, Yorkton light loam and Oxbow loam.

The tillage systems studied were zero, minimum and conventional tillage. Minimum tillage is defined as no fall tillage and one preseeding tillage operation, usually the day before seeding. Conventional tillage involves two fall and one spring preseeding tillage operation, the spring tillage operation also being done one day before seeding. The tillage operation involves the use of a chisel plow with 12" sweeps.

In order to avoid the confounding effects of seeding implement and fertilizer placement with tillage systems, the same seeding implement is used for each tillage system and the same method of fertilizer placement. In order to accomplish this, a commercially available seeder (an Edwards HD812 hoe press drill) was modified so that all the fertilizer could be applied during the seeding operation. This was done by mounting an extra fertilizer box on the drill. The fertilizer from one of the boxes goes down with the seed into the hoe openers and the fertilizer from the extra box is directed into the double offset disc openers. These double disc offset openers were positioned between every second hoe opener so that any given seed row is never more than 10 cm away from the fertilizer band. The row spacing on the machine was 20 cm. Fertilizer used was according to soil test recommendations. The same amount of fertilizer and seed rate was used for all three tillage systems. The same seed source and seeding rates were used at all locations discussed for any given crop in any given year.

Two crop rotations were superimposed on the three tillage systems at Tadmore, Ebenezer, Waldron and Ituna. The two crop rotations involved a continuous and a 50/50 cropping system using canola (var. Westar), HY320 and Katepwa spring wheat. In 1989, HY320 was replaced with two row barley (var. Harrington) and canola with flax (var. Norlin). For 1986, 1987 and 1988, the cropping order was canola → HY320 → Katepwa and for 1989, flax → barley → Katepwa. All crops were present in each year of the study. The Tadmore site was discontinued in 1989 and replaced by the site at Ebenezer. The discussion of results will proceed according to crops investigated.

3.1 Agronomic Results

3.1.1 Oilseed Crops

Canola

Canola production under different tillage and cropping systems was investigated at two locations, Waldron and Ituna, in 1987 and 1988. Of interest was the effect of tillage and cropping systems on plant establishment, plant height, total spring moisture at seeding, and grain yield. A summary of the results is given in Table 3.1.

Plant establishment was not affected by tillage or cropping system at either location. Stand levels were similar under all tillage systems and under stubble and fallow situations.

Plant height was not significantly different for all three tillage systems, but tended to be greater with the zero and minimum till plots. Soil moisture content at seeding time was greater under zero and minimum till than conventional till at Waldron. At Ituna, soil moisture conditions were lower on the zero till plots than the conventional till plots, but the minimum till plots had slightly more water than the conventional till plots.

Final grain yield was affected by tillage systems and cropping systems. The fallow seeded canola outyielded the stubble seeded canola at both locations. The yields under zero and minimum till were significantly lower than the conventional tillage plots at both locations even though at Waldron, the soil moisture conditions were better under zero and minimum tillage and the plants were taller on zero and minimum tillage than conventional tillage at both locations.

In summary, the reduction in yields was not a function of stand establishment or soil moisture differences except at Ituna where the soil moisture conditions were lower for zero till. Plant height was greater for zero and minimum tillage than conventional tillage. There is no reason offered at this time to explain the poor results in canola. Results from the University of Manitoba give canola a 14% yield advantage when seeded under zero till as compared to conventional till. These results were based on 23 station years of data (Stobbe, personal communication).

Table 3.1 The effects of tillage systems and cropping systems on the agronomic performance of canola at different locations.

	Waldron(1987-88)		Ituna(1987-88)	
Tillage System	Stubble	Fallow	Stubble	Fallow
		Plants/m^2		
Zero till	90	83	154	132
Minimum till	110	115	149	144
Conventional till	105	78	127	129
Mean	**102**	**92**	**143**	**135**
S.E.	13		18	
		Plant height (cm)		
Zero till	86	88	91	84
Minimum till	83	80	80	84
Conventional till	80	83	83	86
Mean	**83**	**84**	**85**	**84**
S.E.	4		2	
	Total Spring Soil Moisture 0-120 cm (cm)			
Zero till	29.0	31.2	26.9	27.1
Minimum till	26.3	28.9	31.5	33.9
Conventional till	20.7	25.7	30.1	32.9
Mean	**25.3**	**28.6**	**29.5**	**31.3**
S.E.				
		Yield (kg/ha)		
Zero till	1019	1201	1188	1251
Minimum till	809	1112	1022	1410
Conventional till	1055	1372	1334	1454
Mean	**961**	**1228**	**1182**	**1372**
S.E.	117		97	

Flax

The influence of tillage systems and cropping systems on flax production was investigated at three locations in 1989. It should be noted that at Ituna and Waldron, 1989 represented the fourth year of conservation tillage while at Ebenezer it represented the second year of conservation tillage. A summary of the agronomic results is given in Table 3.2.

Plant establishment was not significantly affected by tillage or cropping system at all locations. Similar plant populations were obtained under fallow and stubble conditions.

Plant height was significantly affected by tillage and cropping system. The zero and minimum till systems tended to produce taller plants than conventional tillage. In some instances there were no differences between fallow and stubble. At one location, Ebenezer, the stubble seeded flax was taller than the fallow seeded flax.

Total spring moisture in the 0-120 cm depth was significantly affected by tillage and cropping systems. The fallow plots had significantly more water at seeding time than the stubble plots which is to be expected, and the zero and minimum till plots had significantly more water than the conventional till plots regardless of whether they were on fallow or stubble. This was consistent at all locations.

Flax yields were increased by zero and minimum tillage systems at two of the three locations, Waldron and Ebenezer. There were no yield differences between tillage systems at Ituna in 1989. This is not surprising considering the very small differences in soil water between tillage systems at Ituna. The yield differences between fallow and stubble were small for all locations where the comparisons were made.

Of interest from the results presented above is that plant establishment was not affected by tillage system; plant height was increased with zero and minimum tillage; zero and minimum tillage increased soil water available for growth and correspondingly, yield was increased significantly with zero and minimum tillage. Flax yields on zero and minimum tillage were never lower than on conventional tillage. Consequently, changing from a conventional to a

zero or minimum till system did not result in short term yield losses, but rather to significant overall yield increases.

Table 3.2 The effects of tillage systems and cropping systems on the agronomic performance of flax at different locations.

	Locations					
Tillage	Ebenezer(1989)		Waldron(1989)		Ituna(1989)	
System	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
				Plants /m^2		
Zero till	607	691	455	437	498	529
Minimum	569	609	407	352	610	498
Conv. till	620	567	435	413	491	541
Mean	**599**	**623**	**432**	**400**	**533**	**523**
S.E.	42		46		44	
			Plant	height	(cm)	
Zero till	57	52	50	54	53	54
Minimum	59	52	45	47	53	53
Conv. till	56	55	46	45	56	54
Mean	**57**	**53**	**47**	**49**	**54**	**53**
S.E.	1.3		2.3		2.0	
Total	**Spring**	**Soil**	**Moisture**	**0-120**	**cm depth**	**(cm)**
Zero till	33.0	34.9	25.0	30.3	22.8	25.2
Minimum	31.2	31.2	22.9	27.3	22.7	26.2
Conv. till	28.5	31.9	27.8	25.8	21.7	23.3
Mean	**30.9**	**32.7**	**25.3**	**27.8**	**22.4**	**24.9**
S.E.	1.2		3.0		1.6	
			Yield	(kg/ha)		
Zero till	1313	1113	1057	1236	658	725
Minimum	1167	1284	826	966	640	849
Conv. till	1001	1232	706	897	743	693
Mean	**1160**	**1210**	**863**	**1032**	**681**	**755**
S.E.	129		61		104	

3.1.2 Cereal Crops

Barley

Barley production under different tillage and cropping systems was investigated at three locations in East Central Saskatchewan in 1989; Ebenezer, Waldron and Ituna. The effects of tillage and cropping systems were determined for plant establishment, number of heads produced, plant height, total soil moisture at seeding time and yield. A summary of these results is given in Table 3.3.

Table 3.3 The effects of tillage systems and cropping systems on the agronomic performance of barley (variety Harrington).

Tillage System	Locations					
	Ebenezer (1989)		Waldron (1989)		Ituna (1989)	
	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
	Plants/m^2					
Zero till	158	158	132	129	137	133
Minimum	171	156	133	149	169	148
Conv. till	177	158	134	128	163	159
Mean	**169**	**158**	**133**	**135**	**156**	**147**
S.E.	10		16		7	
	Heads/m^2					
Zero till	509	656	382	494	400	429
Minimum	521	578	327	418	410	381
Conv. till	453	536	330	437	430	391
Mean	**495**	**590**	**346**	**450**	**413**	**400**
S.E.	26		30		12	
	Plant height (cm)					
Zero till	71	73	51	59	57	62
Minimum	67	71	43	54	54	63
Conv. till	64	73	41	54	62	57
Mean	**67**	**72**	**45**	**55**	**58**	**61**
S.E.	2.0		2.7		2.0	
	Total Spring Soil Moisutre 0-120 cm depth (cm)					
Zero till	32.1	34.1	22.1	26.0	21.1	25.5
Minimum	31.0	34.7	25.8	30.4	24.1	27.1
Conv. till	28.7	33.2	17.5	26.4	19.9	26.1
Mean	**30.6**	**34**	**21.8**	**27.6**	**21.7**	**26.2**
S.E.	1.4		1.8		2.0	
	Yield (kg/ha)					
Zero till	2846	3189	2327	3631	1932	2824
Minimum	2701	3036	1760	3140	1865	2828
Conv. till	2486	2844	1502	2952	2405	2861
Mean	**2678**	**3023**	**1863**	**3241**	**2068**	**2838**
S.E.	126		213		272	

Plant establishment was not significantly affected by tillage or cropping system at any of the locations. The number of heads produced was greater with the zero and minimum tillage systems than the conventional till system at all locations except Ituna. At Ituna, the number of heads produced was the same for all three tillage systems. At all locations, the fallow plots produced more heads than the stubble plots. Plant heights followed a similar pattern as head numbers. The fallow plots produced taller plants under stubble than the conventional till plots except at Ituna where the opposite was observed.

Spring soil moisture was greater under the zero and minimum till systems than the conventional till system at all locations with the differences being the smallest at Ituna. The fallow plots had more water than the stubble plots at all locations regardless of tillage systems used.

Yields were greater on fallow than stubble regardless of tillage system at all locations. At Ebenezer and Waldron, yields on the zero and minimum tillage plots were significantly greater than on the conventional till plots. As well, yields were also greater on the zero and minimum till fallow than the conventional fallow. At Ituna, opposite results were obtained. Yields were significantly greater on the conventional tillage stubble plots than either the zero or minimum tillage plots. There were no differences in yield between tillage systems for the fallow plots. The difference in yield response at Ituna is probably due to the hail damage that occurred on the plots in 1989.

Spring Wheat:

Two classes of spring wheat, hard red spring and prairie spring wheat were studied under different tillage and cropping systems using one variety for each class. Of interest was the effect of tillage and cropping systems on plant establishment, head numbers, plant height, spring soil moisture content at seeding and final grain yield. The same seed source and seeding rate were used at all the locations in any given year and for any given variety.

A summary of the agronomic performance of HY320 from the prairie spring wheat class is given in Table 3.4 for three locations in East Central Saskatchewan. Plant establishment was not affected by tillage system or cropping system for all of the locations as well as

the number of heads per meter square. There were no differences observed for plant height between tillage and cropping systems for all the locations.

Tillage systems had an effect of spring soil moisture at all three locations. The zero and minimum till plots tended to have more water than the conventional till plots. The fallow plots had more water than the stubble plots, regardless of tillage system and location. There were no significant effects of tillage system on yield observed at any of the locations, however, the zero and minimum tillage yields tended to be higher than the conventional till yields. Cropping system (fallow vs stubble) had a significant effect at Ituna. The fallow plots yielded more than the stubble plots. Stubble yields of HY320 averaged 89.5% of the fallow yields at Ituna, 95.3% at Waldron and 99% at Tadmore. There was a significant interaction between tillage system and cropping system at Waldron. The stubble plots yielded more than the fallow plots on the zero till system but the opposite was observed for the conventional tillage system. The zero till stubble plots yielded the same as the conventional fallow plots.

A summary of the agronomic performance of Katepwa from the hard red spring wheat class is given in Table 3.5 for four locations in East Central Sasaktchewan. The same seeding rate and seed source was used in any given year. There is a total of 9 station years of information.

Table 3.4 The effects of tillage systems and cropping systems on the agronomic performance of HY320, Canada Prairie Spring wheat, at different locations.

Tillage System	Locations					
	Waldron (1987-88)		Ituna (1987-88)		Tadmore (1987-88)	
	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
	Plants/m^2					
Zero till	193	227	226	191	193	187
Minimum	226	219	208	192	197	187
Conv. till	216	222	210	270	210	199
Mean	**212**	**223**	**214**	**217**	**200**	**191**
S.E.	13		14		12	
	Heads/m^2					
Zero till	272	219	306	369	284	303
Minimum	239	226	380	356	256	258
Conv. till	236	211	354	340	294	251
Mean	**249**	**219**	**347**	**355**	**278**	**270**
S.E.	20		32		17	
	Plant height (cm)					
Zero till	58	57	52	57	45	47
Minimum	50	51	51	61	47	47
Conv. till	54	56	52	61	47	44
Mean	**54**	**55**	**52**	**60**	**46**	**46**
S.E.	3.0		2.0		2.2	
	Total Spring Soil Moisture 0-120 cm (cm)					
Zero till	28.3	28.8	26.5	30.4	14.9	16.6
Minimum	24.5	25.2	26.7	33.5	14.9	13.8
Conv. till	23.7	27.2	26.8	32.6	13.4	14.8
Mean	**25.5**	**27.1**	**26.7**	**32.2**	**14.4**	**15.1**
S.E.	2.2		1.4		0.3	
	Yield (kg/ha)					
Zero till	2202	1945	2210	2358	1254	1524
Minimum	1562	1677	2222	2739	1331	1148
Conv. till	1723	2132	2344	2473	1216	1188
Mean	**1829**	**1918**	**2259**	**2523**	**1268**	**1273**
S.E.	118		173		80	

Plant establishment was not affected by tillage or cropping systems for all locations and years investigated. Heads per meter square was similar for all locations. Plant height was greater under fallow than stubble regardless of tillage system for all locations. The zero and minimum till system produced taller plants than the conventional till system.

Total soil moisture at seeding time was affected by tillage and cropping systems. The fallow plots had more soil water than the stubble plots at all locations except Tadmore and Ebenezer where the soil water levels were similar. The zero and minimum till plots had significantly more spring soil moisture than the conventional till plots at all locations except Ituna. At Ituna, there were no differences in spring soil moisture between tillage systems.

Yield was significantly affected by tillage and cropping systems. The fallow plots yielded more than the stubble plots at all locations, regardless of tillage systems, except at Tadmore where there were no differences in yield between fallow and stubble. Zero and minimum till yielded significantly more than conventional till at Waldron. At the other locations, the yields were similar. Consequently, decreases in yield were not observed in the short term with the adoption of conservation tillage practices for producing hard red spring wheat. In some cases, the yields were increased.

Table 3.5 The effects of tillage systems and cropping systems on the agronomic performance of Katepwa hard red spring wheat.

Tillage System	Ebenezer(1989)		Waldron(1987-89)		Ituna (1987-89)		Tadmore (1987-88)	
	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow	Stubble	Fallow
				Plants/m^2				
Zero till	331	334	261	283	271	278	304	268
Minimum	328	329	244	261	270	270	288	289
Conv. till	335	299	261	245	259	281	284	298
Mean	**332**	**321**	**255**	**263**	**267**	**276**	**292**	**284**
S.E.	21		10		12		12	
				Heads/m^2				
Zero till	423	471	336	338	425	421	304	268
Minimum	439	413	289	308	425	415	288	289
Conv. till	507	489	280	337	436	419	284	298
Mean	**456**	**458**	**302**	**328**	**429**	**418**	**292**	**286**
S.E.	33		14		17		14	
				Plant height (cm)				
Zero till	90	94	63	67	64	69	42	43
Minimum	90	90	55	58	62	71	57	51
Conv. till	90	98	52	61	65	70	50	50
Mean	**90**	**94**	**57**	**62**	**64**	**70**	**50**	**48**
S.E.	2.5		2.0		2.0		3.0	
				Total Spring Soil Moisture (0-120 cm) (cm)				
Zero till	34.2	31.8	25.4	28.1	25.1	29.4	15.6	14.8
Minimum	31.7	33.2	23.0	27.1	27.8	29.9	16.8	13.4
Conv. till	29.3	30.6	20.0	25.1	25.0	29.5	12.5	15.2
Mean	**31.7**	**31.8**	**22.8**	**26.8**	**25.9**	**29.6**	**15.0**	**14.5**
S.E.	0.8		1.0		1.0		0.8	
				Yield (kg/ha)				
Zero till	2135	2266	1565	1852	1624	2134	876	1076
Minimum	2041	2117	1131	1671	1649	2226	995	793
Conv. till	2060	2380	1269	1765	1887	2096	891	952
Mean	**2078**	**2254**	**1321**	**1763**	**1720**	**2152**	**921**	**928**
S.E.	68		98		96		83	

3.2 Weed Survey

One of the primary concerns expressed by producers regarding the adoption of conservation tillage is the impact it may have on weed populations and the added cost associated with controlling these weeds. The impact of tillage systems on weed populations was given high priority for the research portion of this project. An attempt was made to adopt the weed survey methodology developed at the Regina Research Station to this project in order to try and quantify if changes in weed populations occur with changes in tillage system and if so, at what rate are these changes occurring. The discussion will focus entirely on determining the changes in density of weed types as affected by tillage systems over the last four years at Tadmore, Waldron and Ituna. The results from Ebenezer will not be presented since this site has only been under study for two years.

The first research site to be discussed is Tadmore. A summary of the density of weed types from 1986 to 1988 as affected by tillage systems is given in Table 3.6.

Table 3.6 The effects of tillage systems on weed types (# of weeds per meter square) for 1986, 1987 and 1988 at Tadmore.

	Zero till			Minimum till			Conv. till		
Weed Type	1986	1987	1988	1986	1987	1988	1986	1987	1988
Annual Grass	736.8	536.5	78.7	634.5	310.9	97.4	741.6	231.3	137.5
Annual Broad-leaved	58.5	145.9	35.9	121.1	94.8	27.5	104.2	54.9	22.7
Winter annuals	1.0	1.4	15.3	1.1	2.3	3.8	1.1	0.5	1.6
Perennial weeds	0.7	0.1	6.6	1.5	0.3	0.6	0.9	0.1	0.2
Volunteer crops	0.0	21.3	1.6	0.0	0.8	0.9	0.0	1.2	0.1
Total	797.0	705.2	138.1	758.2	409.1	130.2	847.8	288.0	162.1

The predominant weed type observed at this site was annual grasses. Most of these were made up of green foxtail. From 1986 to 1988 there was a substantial decrease in green foxtail numbers. The overall decrease in weed densities from 1986-1988 can be accounted for almost entirely on the basis of a decrease in the density of annual grasses. With regards to the other weed types, no significant changes could be observed. After three years of research on this site, the overall density of weeds has decreased and densities remaining were similar for all three tillage systems.

The next research site to be discussed is the Waldron. A summary of the density of weed types from 1986 to 1989 as affected by tillage systems is given in Table 3.7. Overall, the density of weed types tended to be on the low side and similar for all tillage systems at the start of the experiment in 1986. After four years, the densities have remained low and relatively constant for the zero and minimum tillage systems. There appears to have been a slight increase in weed densities under the conventional tillage system. Consequently, after four years, there has been no noticeable changes in weed types and densities regardless of tillage system used.

Table 3.7 The effects of tillage systems on post herbicide application weed type densities (# of weeds per meter square) for 1986-1989 at Waldron.

	Zero till				Minimum till				Conv. till			
Weed Type	1986	1987	1988	1989	1986	1987	1988	1989	1986	1987	1988	1989
Annual Grass	3.0	9.7	7.4	11.5	1.8	7.3	9.0	17.3	2.3	4.8	17.3	49.6
Annual Broad-leaved	9.0	20.8	18.2	8.8	10.0	16.6	13.8	7.0	7.7	19.4	17.0	7.1
Winter annuals	0.1	0.0	1.3	0.2	0.0	0.0	1.2	0.2	0.0	1.0	2.5	0.5
Per-ennial weeds	7.9	0.3	3.6	3.9	9.0	17.9	7.0	5.1	7.1	2.1	4.4	1.7
Volun-teer crops	0.7	0.4	0.0	5.3	0.0	1.7	0.3	2.8	0.0	2.8	0.3	0.9
Total	20.7	31.2	30.5	29.7	20.8	43.5	31.3	32.4	17.1	30.1	41.5	59.8

The last research site to be discussed is Ituna. A summary of the density of weed types from 1986-1989 as affected by tillage system is given in Table 3.8. The general tendency has been for weed densities to decrease over the four year period for all three tillage systems. The decrease was more rapid for the minimum and conventional tillage systems. Overall there has been a decrease in weed densities with no apparent changes in the types of weed present.

Table 3.8 The effects of tillage systems on weed type densities (# of weeds per meter square) for 1986-1989 at Ituna.

	Zero till				Minimum till				Conv. till			
Weed Type	1986	1987	1988	1989	1986	1987	1988	1989	1986	1987	1988	1989
Annual Grass	7.6	2.0	2.4	1.0	8.3	2.6	1.6	0.8	14.1	6.4	1.4	0.8
Annual Broad-leaved	14.3	33.0	6.4	14.4	11.1	13.3	5.9	6.4	15.5	9.4	8.7	5.4
Winter annuals	0.1	0.0	0.1	1.0	0.2	0.7	0.1	0.1	0.0	1.9	0.1	0.2
Per-ennial weeds	1.7	2.9	2.1	1.6	3.4	1.4	1.7	2.3	0.4	2.2	2.1	2.3
Volunteer crops	24.4	8.3	0.1	5.2	19.5	7.0	0.1	2.1	17.2	0.5	0.1	0.5
Total	48.1	46.2	11.1	23.2	42.5	25.0	9.4	11.7	47.2	20.4	12.4	8.4

Based on the results of 11 station years of research spread over three locations, the adoption of conservation tillage has not resulted in increased weed densities, and there was no observable shift in the types of weeds present on the research site, given the weed populations observed at the start of the experiment.

4.0 ECONOMIC RESULTS

The development and promotion of new crop production systems have to be agronomically and economically sound. The previous section has shown that these new approaches to crop production through soil conservation practices are agronomically feasible. This section will discuss the economic viability of these soil conservation production systems.

There is always the danger of making unrealistic assumptions when discussing crop production from an economic standpoint. Input costs such as seed, fertilizer and herbicides are easy to determine. The difficult part comes in putting a cost factor on equipment, interest on investment and labour. In order to simplify these problems, custom and rental prices from the Machinery Custom and Rental Rate Guide published by the Economics Branch of

Saskatchewan Agriculture and Food were used for these costs. The assumptions used in that guide are:

1) Interest on investment as calculated at 10% (assumes 50% owned and 50% borrowed).

2) Diesel fuel is charged at 0.29/li and gasoline at 0.31/li. Oil and grease at 0.35/100 HP.

3) Labour is charged at $9.00/hour.

The final dollar figure used for machinery costs was determined by multiplying the rates in the guide by 0.70. The production economics will be discussed by crop.

4.1 Oilseeds

Canola

The production costs as affected by tillage and cropping systems for canola are given in Table 4.1 for two locations and two years of production. The first important observation is that canola under a continuous cropping scenario gave higher net returns than on a 50/50 crop fallow rotation. In both cases, continuous cropping combined with the conventional tillage system gave the highest net return at both locations over two years. The adoption of conservation tillage systems did not improve the net returns. The major cost differences between the various tillage systems was cost of herbicides. Significant yield increases are required to offset the additional herbicide costs. The yield differences reported by the University of Manitoba in favour of conservation tillage for canola could have possibly offset these extra costs. The significant finding was that stubble canola was more profitable than fallow cropped canola.

Another important point is that the price of glyphosate has decreased by more than 50% since the start of the study. If these economic analyses were to be adjusted to reflect these lower prices of glyphosate, the economic scenarios would be somewhat different.

Table 4.1 The effects of tillage and cropping systems on production costs and net returns of canola at two locations.

Location	Cropping System	Tillage System	Seeding Costs	Tillage Costs	Herbicide Costs	Herbicide App. Cost	Fertilizer Costs	Fallow Costs	Total Costs	Unit Price	Yield (kg/ha)	Crop Return	Net Return
			-------	-------	----------	$/ha-----	----------	-------	-------	$/tonne		----$/	ha----
					Canola	(Var.	Westar)						
Waldron	Cont.	Zero	40.38	0.00	143.23	12.19	47.37	0	271.87	276.17	1019	281.42	9.55
1987-88		Min.	40.38	10.25	121.86	9.38	47.37	0	257.94	276.17	809	223.42	-34.52
		Conv.	40.38	19.12	91.07	3.75	47.37	0	230.40	276.17	1055	291.36	60.96
	50/50	Zero	40.38	0.00	96.59	5.63	47.37	123.52	342.18	276.17	1201	331.68	-10.50
		Min.	40.38	5.13	96.59	5.63	47.37	97.59	321.38	276.17	1112	307.10	-14.28
		Conv.	40.38	14.00	85.79	3.75	47.37	39.75	259.74	276.17	1372	378.91	119.17
Ituna	Cont.	Zero	40.38	0.00	87.43	13.35	54.54	0	218.20	276.17	1188	328.09	109.89
1987-88		Min.	40.38	10.25	58.13	7.72	54.54	0	193.52	276.17	1022	282.25	88.73
		Conv.	40.38	19.12	55.47	3.97	54.54	0	195.99	276.17	1334	368.41	172.42
	50/50	Zero	40.38	0.00	68.24	7.72	54.54	90.94	284.32	276.17	1251	345.49	61.17
		Min.	40.38	5.13	86.52	7.72	54.54	64.62	281.41	276.17	1410	389.40	107.99
		Conv.	40.38	14.00	65.31	3.97	54.54	39.75	240.45	276.17	1454	401.55	161.10

Flax

The production costs for flax as a function of tillage and cropping systems are given in Table 4.2 for three locations. The conclusions are easy to draw. At all locations, stubble flax was more profitable than fallow grown flax. The other conclusion is that stubble flax grown using conservation tillage practices gave higher net returns than when grown using conventional tillage practices at two of the three locations. A close examination of the data also reveals that much of the cost differences between tillage systems under a continuous cropping scenario is associated with the cost of the spring chemical burnoff treatment prior to seeding. Consequently, only small increases in yields are required to cover these extra costs.

4.2 Cereals

Barley

Barley was included in the rotation in 1989, replacing HY320. The results discussed represent one year of production at three different locations. At Waldron and Ituna, 1989 represents the fourth year of research on these sites while at Ebenezer, the second year. A summary of the economic analysis is given in Table 4.3. Overall, continuous cropped barley was profitable at only one location, Ebenezer. At the other locations, there was a net loss, but the losses were greater on conventional tillage than on conservation tillage at Waldron while the opposite was true for Ituna. Under a fallow cropping scenario, the highest net returns were obtained with conventional fallow because of the higher costs associated with chemical fallow as compared to conventional tillage fallow. The low commodity prices for barley are such that large yield increases are required to offset the extra costs of herbicides for controlling weeds.

Canada Prairie Spring Wheat

HY320 was grown at three locations in each of two years for a total of 6 station years. A summary of the economic analysis is given in Table 4.4. Continuous cropping combined with conservation tillage tended to give the highest returns at two locations and at the third location, the losses were least with continuous cropping. The low commodity prices experienced during 1987 and 1988 resulted in

poor overall economic performance of HY320 regardless of tillage or cropping system. Under a continuous cropping scenario, the difference in total cost between zero till and conventional till was $20.29/ha or $8.11/acre. Given the large reduction in glyphosate prices during the last year, which is not included in these economic analyses, it can be concluded that the total variable costs associated with conservation tillage are very similar to the cost of production with conventional tillage.

Hard Red Spring Wheat

Katepwa spring wheat was grown at four different locations from 1987 to 1989 for a total of nine station years of results. A summary of the economic analysis is given in Table 4.5. The first conclusion that can be made is that continuous cropping was more profitable than fallow cropping at three of the four locations. The fourth location, Tadmore, showed losses on both fallow and continuous cropping. The average difference in total costs between zero till continuous cropping and conventional till continuous cropping was $23.00/ha or $9.20/acre, the equivalent of a chemical preseeding burnoff treatment. Consequently, given the fact that glyphosate costs were not adjusted to reflect the current lower prices, it can be concluded that the overall cost differences between zero till and conventional till cropping are very similar. If one considers the long term benefits of protecting the soil against erosion, then zero till cropping should be an economically viable production practice, given the results presented above.

4.3 Economics of Chemical Fallow

One of the objectives of this project was also to investigate alternate fallow practices and the economics of these alternate practices. A quick glance at the economics of fallowing using zero, minimum or conventional tillage practices in Table 4.1-4.5 will put this whole area into perspective very quickly. The costs associated with chemical fallow are exorbitant compared to conventional tillage fallow practices. Also, the results from the economics of continuous cropping are such that fallowing is not a requisite for economic viability in East Central Saskatchewan. It is very hard to justify the adoption of chemical fallow given the economics of continuous cropping.

Table 4.2 The effects of tillage and cropping systems on production costs and net returns of flax at three locations.

Location	Cropping System	Tillage System	Seeding Costs	Tillage Costs	Herbicide Costs	Herbicide App. Cost	Fertilizer Costs	Fallow Costs	Total Costs	Unit Price	Yield (kg/ha)	Crop Return	Net Return
			-------	-------	----------	$/ha-----	----------	-------	-------	$/tonne		----$/	ha----
					Flax	(Var.	Norlin)						
Ebenezer	Cont.	Zero	47.20	0.00	51.53	9.38	20.31	0	150.92	336.24	1313	441.48	290.56
1989		Min.	47.20	7.50	59.66	7.50	20.31	0	164.67	336.24	1167	392.39	227.72
		Conv.	47.20	17.75	38.81	3.75	20.31	0	150.32	336.24	1084	364.48	214.17
	50/50	Zero	47.20	0.00	50.18	8.44	20.31	54.00	202.63	336.24	1113	374.30	171.67
		Min.	47.20	7.50	38.81	3.75	20.31	46.25	186.32	336.24	1284	431.87	245.55
		Conv.	47.20	7.50	38.81	3.75	20.31	30.75	170.82	336.24	1232	414.38	243.56
Waldron	Cont.	Zero	47.20	0.00	71.13	10.32	42.88	0	194.03	336.24	1057	355.54	161.51
1989		Min.	47.20	7.50	63.43	7.51	42.88	0	191.02	336.24	826	277.77	86.75
		Conv.	47.20	17.75	38.81	3.75	42.88	0	172.89	336.24	706	237.22	64.33
	50/50	Zero	47.20	0.00	58.42	8.45	42.88	73.46	252.91	336.24	1236	415.46	162.55
		Min.	47.20	7.50	38.81	3.75	42.88	52.51	215.15	336.24	967	324.71	109.56
		Conv.	47.20	7.50	38.81	3.75	42.88	30.75	193.39	336.24	897	301.57	108.19
Ituna	Cont.	Zero	47.20	0.00	74.07	11.25	37.96	0	192.98	336.24	658	221.38	28.40
1989		Min	47.20	7.50	48.69	7.50	37.96	0	171.35	336.24	640	215.23	43.88
		Conv.	47.20	15.00	38.81	3.75	37.96	0	165.22	336.24	743	249.96	84.74
	50/50	Zero	47.20	0.00	64.08	11.26	37.96	139.56	322.56	336.24	725	243.61	-78.95
		Min.	47.20	7.50	54.75	7.50	37.96	72.51	249.92	336.24	849	285.47	35.55
		Conv.	47.20	7.50	38.81	3.75	37.96	41.00	198.72	336.24	692	232.88	34.16

Table 4.3 The effects of tillage and cropping systems on production costs and net returns of barley at three locations.

Location	Cropping System	Tillage System	Seeding Costs	Tillage Costs	Herbicide Costs	Herbicide App. Cost	Fertilizer Costs	Fallow Costs	Total Costs	Unit Price	Yield (kg/ha)	Crop Return	Net Return
			-------	-------	----------	$/ha-----	----------	-------	-------	$/tonne		----$/	ha----
					Barley	(Var	Harrington)						
Ebenezer	Cont.	Zero	32.07	0.00	51.38	12.20	29.92	0	148.07	66.15	2846	188.27	40.20
1989		Min.	32.07	7.50	55.90	10.31	29.92	0	158.20	66.15	2701	178.68	20.48
		Conv.	32.07	17.75	40.26	7.50	29.92	0	150.00	66.15	2487	164.51	14.51
	50/50	Zero	32.07	0.00	51.63	12.19	29.92	54.00	202.31	66.15	3189	210.95	8.64
		Min.	32.07	7.50	40.26	7.50	29.92	46.25	186.00	66.15	3037	200.88	14.88
		Conv.	32.07	7.50	40.26	7.50	29.92	30.75	170.50	66.15	2844	188.15	17.65
Waldron	Cont.	Zero	32.07	0.00	64.53	13.14	53.03	0	185.27	66.15	2327	153.92	-31.35
1989		Min.	32.07	7.50	58.81	11.26	53.03	0	185.17	66.15	1760	116.44	-68.73
		Conv.	32.07	17.75	40.26	7.50	53.03	0	173.11	66.15	1502	99.35	-73.76
	50/50	Zero	32.07	0.00	59.18	12.20	28.22	73.46	227.63	66.15	3651	241.53	13.89
		Min.	32.07	7.50	40.26	7.50	28.22	52.51	190.56	66.15	3140	207.73	17.17
		Conv.	32.07	7.50	40.26	7.50	28.22	30.75	168.80	66.15	2952	195.28	26.48
Ituna	Cont.	Zero	32.07	0.00	56.66	12.19	49.07	0	172.49	66.15	1932	127.82	-44.68
1989		Min	32.07	7.50	32.69	7.50	49.07	0	151.33	66.15	1865	123.38	-27.96
		Conv.	32.07	15.00	32.69	7.50	49.07	0	158.83	66.15	2405	159.11	0.28
	50/50	Zero	32.07	0.00	48.02	13.13	30.46	139.56	285.74	66.15	2824	186.83	-98.90
		Min.	32.07	7.50	35.16	8.44	30.46	72.51	208.64	66.15	2828	187.08	-21.56
		Conv.	32.07	7.50	32.69	7.50	30.46	41.00	173.72	66.15	2861	189.28	15.56

Table 4.4 The effects of tillage and cropping systems on production costs and net returns of HY320 spring wheat at three locations.

Location	Cropping System	Tillage System	Seeding Costs	Tillage Costs	Herbicide Costs	Herbicide App. Cost	Fertilizer Costs	Fallow Costs	Total Costs	Unit Price	Yield (kg/ha)	Crop Return	Net Return
			-------	-------	----------	$/ha-----	----------	-------	-------	$/tonne		----$/	ha----
					HY320	Spring	Wheat						
Waldron	Cont.	Zero	49.83	0.00	64.65	14.53	42.80	0	194.31	93.94	2202	206.86	12.55
1987-88		Min.	49.83	10.25	30.57	9.83	42.80	0	165.33	93.94	1562	146.73	-18.60
		Conv.	49.83	22.87	26.74	5.63	42.80	0	170.37	93.94	1723	161.86	- 8.51
	50/50	Zero	49.83	0.00	37.47	9.38	42.80	120.09	282.06	93.94	1945	182.71	-99.35
		Min.	49.83	12.50	33.85	16.25	42.80	65.46	143.58	93.94	1677	157.54	13.96
		Conv.	49.83	16.37	26.74	5.63	42.80	39.75	203.62	93.94	2132	200.28	- 3.34
Ituna	Cont.	Zero	49.82	0.00	80.40	15.00	49.71	0	217.43	93.94	2210	207.61	- 9.82
1987-88		Min.	49.82	10.25	49.38	9.38	49.71	0	191.04	93.94	2222	208.73	17.69
		Conv.	49.82	22.87	45.55	5.63	49.71	0	196.09	93.94	2344	220.20	24.11
	50/50	Zero	49.82	0.00	56.28	9.38	49.71	90.94	278.63	93.94	2358	221.51	-57.12
		Min.	49.82	5.13	58.08	9.38	49.71	61.66	256.28	93.94	2739	257.30	1.02
		Conv.	49.82	14.00	45.55	5.63	49.71	39.58	226.80	93.94	2473	232.31	5.51
Tadmore	Cont.	Zero	46.59	0.00	91.78	13.13	103.92	0	277.91	93.94	1254	117.80	-160.1
1987-88		Min	46.59	10.25	70.28	9.38	103.92	0	262.91	93.94	1331	125.03	-137.8
		Conv.	46.59	17.75	66.03	5.63	103.92	0	262.41	93.94	1216	114.23	-148.1
	50/50	Zero	46.59	0.00	91.78	13.13	103.92	60.80	338.44	93.94	1524	143.16	-195.2
		Min.	46.59	10.25	70.28	9.38	103.92	41.67	304.58	93.94	1148	107.84	-230.6
		Conv.	46.59	17.75	66.03	5.63	103.92	42.00	304.41	93.94	1188	111.60	-192.8

Table 4.5 The effects of tillage and cropping systems on production costs and net returns of Katepwa spring wheat at four locations.

Location	Cropping System	Tillage System	Seeding Costs	Tillage Costs	Herbicide Costs	Herbicide App. Cost	Fertilizer Costs	Fallow Costs	Total Costs	Unit Price	Yield (kg/ha)	Crop Return	Net Return
			-------	-------	----------	$/ha-----	----------	-------	-------	$/tonne		----$/	ha----
					Hard Red	Spring	Wheat	Var.	Katepwa				
Waldron	Cont.	Zero	43.75	0.00	60.64	13.13	44.15	0	184.16	128.06	1565	200.41	16.25
1987-89		Min.	43.75	9.33	35.19	8.75	44.15	0	163.87	128.06	1131	144.84	-18.83
		Conv.	43.75	18.67	25.75	5.00	44.15	0	159.81	128.06	1269	162.51	2.70
	50/50	Zero	43.75	0.00	38.37	8.75	44.15	104.55	262.06	128.06	1852	237.17	-24.89
		Min.	43.75	5.92	27.16	6.25	44.15	80.40	230.12	128.06	1671	213.99	-16.13
		Conv.	43.75	11.83	25.75	5.00	44.15	36.75	189.73	128.06	1765	226.03	36.30
Ituna	Cont.	Zero	43.75	0.00	76.25	15.00	46.40	0	203.90	128.06	1624	207.97	4.07
1987-89		Min.	43.75	9.33	49.13	10.00	46.40	0	181.11	128.06	1649	211.17	30.06
		Conv.	43.75	17.75	41.27	6.25	46.40	0	177.91	128.06	1887	241.65	63.74
	50/50	Zero	43.75	0.00	55.17	11.25	44.33	105.01	282.01	128.06	2134	273.28	- 8.73
		Min.	43.75	5.92	49.62	8.75	44.33	65.28	240.15	128.06	2226	285.06	44.91
		Conv.	43.75	11.83	41.27	6.25	44.33	40.17	210.10	128.06	2096	268.41	58.31
Ebenezer	Cont.	Zero	48.54	0.00	52.98	13.13	29.92	0	167.07	137.73	2135	294.11	127.04
1989		Min	48.54	7.50	52.29	10.32	29.92	0	171.07	137.73	2040	281.07	110.00
		Conv.	48.54	17.75	40.26	7.50	29.92	0	166.47	137.73	2060	283.75	117.28
	50/50	Zero	48.54	0.00	51.63	12.19	29.92	54.00	218.78	137.73	2269	312.08	93.30
		Min.	48.54	7.50	40.26	7.50	29.92	46.25	202.47	137.73	2117	291.60	89.13
		Conv.	48.54	7.50	40.26	7.50	29.92	30.75	186.97	137.73	2380	327.74	140.77
Tadmore	Cont.	Zero	42.02	0.00	91.78	13.13	103.92	0	273.34	137.73	876	120.65	-17.08
1987-88		Min.	42.02	10.25	70.28	9.38	103.92	0	258.34	137.73	995	137.24	- 0.49
		Conv.	42.02	17.75	66.03	5.63	103.92	0	257.57	137.73	891	122.72	-15.01
	50/50	Zero	42.02	0.00	91.78	13.13	103.92	60.80	334.14	137.73	1076	148.20	10.47
		Min.	42.02	10.25	70.28	9.38	103.92	41.67	300.02	137.73	793	109.22	-28.53
		Conv.	42.02	17.75	66.03	5.63	103.92	42.00	299.84	137.73	952	131.12	- 6.61

5.0 SUMMARY

Soil Water Conservation

The adoption of soil conservation practices resulted in increased spring soil moisture content. In certain instances, the soil water conserved under a continuous cropping system using zero till practices, exceeded soil moisture conserved under conventional tillage and a 50/50 cropping system. Overall, conservation tillage will improve soil water available for crop growth.

Weed Populations

The overall density of weeds tended to decrease from the start of the experiment regardless of tillage systems at all locations under study. No changes in weed types were observed as a function of tillage systems. It is concluded that with proper crop rotations and weed management, the density of weeds can be maintained at low levels and if changes are to occur, these changes are slow; much slower than previously anticipated.

Yield

The yields under conservation tillage, on average, were equal or better than under conventional tillage. In some instances, the yield increases over conventional tillage were substantial-especially with zero tillage practices. It is safe to conclude that with proper management, the adoption of conservation tillage does not result in yield depressions in the short term. The long term view would be for increased yields with conservation tillage.

Production Economics

Given the sharp decline in glyphosate prices (approximately 50%) since the start of this experiment (which is not reflected in the economic analysis discussed in the report as the prices used were based on the cost of the product at the time of the experiment), it is almost safe to assume that the costs associated with zero till continuous cropping are very similar to the costs associated with conventional tillage practices using a stubble cropping system. The cost of chemicals during the chemical fallow year were exorbitantly higher than the costs associated with tillage fallow and for that reason, zero till fallow cropping was not economically attractive. In

many instances, continuous cropping using conservation tillage practices was more profitable than conventional stubble cropping practices. Overall, the economic analyses tend to favour continuous cropping combined with conservation tillage practices. With the significant reduction in glyphosate prices, it can be argued that zero till continuous cropping can be a viable cropping alternative and may alleviate the need for using fallow in the rotation.

DEMONSTRATION SITES

1.0 INTRODUCTION

One demonstration project has been established in each of the eight agricultural extension districts that make up the East Central Region. These are field scale farmer co-operator sites that are planned in co-operation with the local extension agrologist and district ADD board. The objectives are to illustrate some practical aspect of soil conservation in each district that is of interest or concern to local producers. Four years of data has been collected from these sites as of 1989.

2.0 RESULTS OF DEMONSTRATIONS

The yield data from these demonstration projects represents the average yield from several test strips harvested within each plot. Although trends may appear in the data when the results are compared from year to year, there is no statistical significance to the variations (ie: there is no measurement of error attached to these values). The remarks and observations made are not conclusive and are included for discussion purposes only.

The economic returns presented are based on net returns ($/acre) to operating costs. This includes direct cash costs such as cropping inputs, machinery costs and crop insurance and indirect costs such as taxes, utilities and building upkeep, etc. The economic analyses do not reflect interest on operating loans, or fixed costs such as land costs or living allowance. A detailed description of expenses and returns for each demonstration project is given in each of the project's Annual Reports.

Agronomy information for each demonstration site has not been included in the Four Year Summary. This information is provided in each of the Annual Reports. Seeding dates, seeding rates and fertilizer treatments at each site were similar to the methods predominant in that area. Where more than one seeding implement was used, the date of seeding, seeding rate, seeding depth and fertilization rate was kept constant to eliminate confounding effects.

2.1 EXTENSION DISTRICT #12 - YORKTON

OBJECTIVES: To determine how tillage treatments and seeding systems influence crop yield and residue management under extended cropping conditions.

RESULTS:

1986: In 1986, the Yorkton site compared the conventional practice of pre-working and press drill seeding to direct seeding into fall worked stubble with an airseeder.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1 & 2	Conventional till-double disc drill	44.8	23.84
3 & 4	Minimum till-airseeder	41.8	22.02

Even with two additional tillage treatments, the conventional plots produced higher yields and net returns than the minimum tillage treatment. Some of the difference may be attributed to the packing capabilities of the two seeding systems.

1987: In 1987, this site evaluated the effects of fall tandem discing on crop yield and return.

Crop: Columbus wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Double disc press drill-tandem disced	35.5	1.02
2	Double disc press drill	34.0	2.13
3	Airseeder	32.0	- 3.20
4	Airseeder-tandem disced	31.7	- 9.04

The press drill continued to outperform the airseeder. The use of a tandem disc reduced the net return in both seeding systems.

1988: In 1988, canola was seeded into wheat stubble. Half of the plot was treated with a pre-emergent herbicide (and the associated tillage) while the other half was treated post-emergent and received less tillage.

Crop: Westar canola

Plot #	Plot Description		Yield bu/acre	Net Return $/acre
1	Post-emergent	Airseeder	22.0	62.05
2	Pre-emergent	Press drill	24.0	75.74
3	Pre-emergent	Airseeder	23.3	70.78
4	Post-emergent	Press drill	17.8	32.80

The pre-emergent treatments produced the highest yields and net returns. This was due to the grassy and broadleaf weed competition on plots 1 and 4 prior to spraying and the resulting dockage losses that reduced the final yield.

1989: In 1989, the Yorkton site evaluated the effects of fall versus spring banding. Half of the plot was not worked in the fall so that snow trapping and moisture conservation could be evaluated.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Fall banded, pre-emergent	25.3	- 7.01
2	Spring banded, post-emergent	25.4	- 0.55
3	Fall banded, post-emergent	23.6	-11.62
4	Spring banded, pre-emergent	23.8	-12.61

The highest yield and net return were achieved on plot #2 which received no fall tillage and did not have a pre-emergent herbicide incorporated into it in the spring.

2.2 EXTENSION DISTRICT #13 - MELVILLE

OBJECTIVES: To study various types and amounts of fall and spring tillage to determine which methods provide suitable seedbed preparation and yet provide adequate trash cover for erosion protection.

RESULTS:

1986: In 1986, the entire field had the same treatments to accomodate the site's establishment. Tillage treatments began after the 1986 harvest.

Crop: Neepawa wheat

Plot Description	Yield bu/acre	Net Return $/acre
1 fall tillage; 1 spring tillage; spring banding; airseeder operation; harrowed	24.0	-21.08

1987: After the 1986 harvest, the site was divided into 10 treatments to examine a wide range of fall and spring tillage combinations as well as fall versus spring fertilization.

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
	Fall Operations:Spring Operations		
1	Fall till/fall band:spring till/seed on fallow	40.7	- 5.71
2	Fall till/fall band: spring till/seed on stubble	30.9	- 6.83
3	One fall tillage/fall band:seed	32.4	- 7.29
4	One fall tillage: spring band/seed	31.2	-10.16
5	Two fall tillage:spring band/seed	33.8	- 7.67
6	Fall band:spring till/seed	33.2	- 5.03
7	Fall band:seed	32.9	- 2.38
8	No fall work:spring band/seed	35.7	4.31
9	No fall work:spring till/band/seed	35.2	0.94
10	Fall chemical fallow:spring band/seed	34.4	- 4.06

Remarks: Plot #1, which was summerfallow in 1986, produced the highest yield and higher protein content than plots #5 and #6 which were cultivated or banded in the fall. Plots receiving

no fall tillage or banding (plots #8, 9, 10) produced higher yields than those plots that were cultivated and/or banded in the fall. Plot #8, which had no fall tillage, produced the highest returns.

1988: In 1988, plot treatments remained identical to 1987, except all crop was seeded on stubble.

Crop: Neepawa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
	Fall Operations:Spring Operations		
1	Fall till/fall band:spring till/seed	27.1	46.00
2	Fall till/fall band: spring till/seed	31.2	56.61
3	One fall tillage/fall band:seed	29.3	52.35
4	One fall tillage: spring band/seed	27.7	46.02
5	Two fall tillage:spring band/seed	29.6	48.58
6	Fall band:spring till/seed	29.2	51.90
7	Fall band:seed	31.0	45.04
8	No fall work:spring band/seed	33.5	55.43
9	No fall work:spring till/band/seed	36.9	79.10
10	Fall chemical fallow:spring band/seed	33.8	74.05

The highest net returns were achieved on plots #9 and #10 where no fall tillage was done. Plots #8 -#10 had noticeably higher levels of soil moisture prior to seeding in the spring and produced higher yields than those plots that were cultivated and/or banded in the fall. This observation concurs with data from 1987. The lowest returns were achieved on plot #7 where no spring tillage was done (other than seeding). The combined effects of no spring tillage and excellent moisture conditions resulted in delayed maturity and downgrading on plot #7. All plots were harvested on the same day.

1989: The 1988 stubble was left undisturbed into 1989. The site was changed from 10 plots to four larger ones where a comparison of seed placed versus deepbanded fertilizer was examined in conjunction with different spring tillage treatments. All treatments were done with an airseeder.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Direct seeded/seedplaced 35-15-0	24.8	10.34
2	Spring banded; seeded	21.2	-0.21
3	Spring tilled; spring banded; seeded 35-15-0	20.9	-5.02
4	Spring tilled; seeded/seedplaced	24.5	14.92

The highest yields were achieved with plots #1 and #4 which had minimum tillage treatments. In both cases 100 lbs/ac of 35-15-0 was seedplaced to supply the required nutrients. Even though plot #1 yielded slightly higher than #4, the grain graded lower resulting in the lower net return. The entire site was harrowed once following seeding.

2.3 EXTENSION DISTRICT #18 - KAMSACK

OBJECTIVES: This site studies straw management under extended cropping conditions. This includes comparisons of minimum tillage and conventional tillage with respect to seedbed preparation and seeding method.

RESULTS:

1986: In the fall of 1985 the entire site was deeptilled once. In the spring of 1986, 110 lbs/ac of 46-0-0 was deepbanded into the two treatments. One treatment was seeded with an airseeder and the other with a double disc press drill. Both treatments were harrowed post-seeding.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Minimum tillage - airseeder	39.0	37.23
2	Conventional tillage-double disc press drill	35.1	27.64

Despite similar field conditions at seeding for both plots, the airseeder still produced 3.9 bu/ac more wheat and $9.59 better return than the double disc press drills.

1987: In 1987, this site studied minimum tillage seeding where seeding and fertilizing were combined into one operation with an airseeder, in comparison with the conventional method of pre-plant nitrogen banding, followed by seeding and seed placing the phosphate requirements. No fall tillage was done in 1986. All plots were cultivated 3" deep in the spring of 1987. One post seeding harrowing operation was done on all plots as well.

Crop: Heartland barley

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	N-58.5 lb/ac seedplaced as 26-13-0; P-29.3 lb/ac seedplaced as 26-13-0	65.0	54.28
2	Unfertilized	22.5	- 3.71
3	N-52.0 lb/ac spring banded as 46-0-0; P-30.0 lb/ac seedplaced as 11-51-0	85.0	88.96

The plot where nitrogen was banded (plot #3) produced the highest yield of Heartland barley, despite the additional field operation. Some of the difference may be attributable to seedling damage in plot #1 from the high rate of seedplaced nitrogen.

1988: In 1988, this site studied the conventional method of growing canola, where pre-emergent herbicides are incorporated into the soil in comparison to a reduced tillage system involving post-emergent weed control. The main point of interest is the tillage associated with pre-emergent herbicides and not simply the comparison of herbicides. All plots were cultivated once in the fall of 1987 and again in the spring of 1988 with a heavy duty cultivator. Plots #2 and #3 then recieved another working with a field cultivator followed by a deep banding operation on all plots. All plots were harrowed once after seeding.

Crop: Tobin canola

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Reduced till; Excel	16.80	28.15
2	Conventional till; Rival EC	17.80	26.71
3	Conventional till; Edge DF	17.50	27.39

The highest initial yields were achieved on the conventional plots where pre-emergent herbicides were used. The yield of the reduced till (post-emergent) plot was reduced due to grassy weed pressure prior to application of the herbicide. However, due to dockage losses (volunteer barley) the net yield and return of the conventional treatments (plots #2 and #3) was slightly lower than the net yield and return on plot #1, the reduced tillage treatment.

1989: In 1989, the site was reduced to three plots and a comparison of PB-50 with one half the rate of 11-51-0 and the straight full rate of 11-51-0 was done. All plots were deepbanded with 110 lbs per acre of 46-0-0.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	No phosphate	22.8	10.30
2	25 lbs/ac phosphate; PB-50	26.8	22.15
3	50 lbs/ac phosphate	21.2	-0.10

Although plot #2 with the PB-50 treatment yielded highest, it should be noted that there is no input cost associated with PB-50 at this time because it is not yet on the market. If a true comparison is to be done, the cost of the PB-50 will have to be added to the total expenses of plot #2 ($64.15/ac) and subtracted from the gross returns based on CGC grade ($87.13/ac). It is interesting to observe that the full rate of phosphate on treatment #3 and no phosphate in treatment #1 produced similar yields, but the net returns of the lower input plot surpass plot #3 by $10.40.

2.4 EXTENSION DISTRICT #19 - CANORA

OBJECTIVES: Conventional seedbed preparation in this area includes fall and spring tillage to reduce surface residues and to dry the soil surface. Seeding is normally done with a double disc press drill. The project compares the conventional tillage/seeding system with a system that uses either an airseeder or a hoe press drill to reduce tillage and maintain surface residues. This site compares the economic and agronomic feasibility of three seeding systems and the tillage practices required by each to provide a satisfactory seedbed while also ensuring that there is adequate trash cover for erosion protection. The three systems are: airseeder, hoe press drill and double disc press drill.

RESULTS:

1986: A blend of 120 lbs of urea and 40 lbs of 11-51-0 was spring banded. A further 6 lbs of 11-51-0 were seedplaced. Soil conditions and tillage treatments were identical across all 3 plots. All 3 plots were sprayed with 1.4 L/ac of Hoegrass II.

Crop: Selkirk wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Hoe press drill	35.25	11.83
2	Airseeder	37.90	18.84
3	Double disc press drill	34.40	9.70

Even though field conditions on each plot were similar and tillage treatments identical, the airseeder plot produced 2.65 bu/ac more than the hoe press drill and 3.50 bu/ac more grain than the double disc press drill.

1987: All plots were cultivated and harrowed once in the fall of 1986. Again, all plots were treated identically. They were deepbanded with 60 lbs N/ac of 46-0-0 and then 11-51-0 was seedplaced at 30 lbs P/ac. All plots were treated with the post-emergent herbicide Hoegrass II at 1.4 L/ac.

Crop: Harrington barley

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Hoe press drill	55.9	88.73
2	Airseeder	55.8	88.47
3	Double disc press drill	52.4	78.44

As in 1986, the hoe drill and airseeder outdid the disc drill in yield and more significantly, in net return in 1987.

1988: In 1988, an addition was made to the double disc press drill treatment. Half of the press drill treatment received an extra spring tillage operation. In 1988, wheat was seeded on barley stubble. With the exception of plot #4, all treatments received the same amount and type of tillage practices.

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Hoe press drill	32.3	59.27
2	Airseeder	23.6	21.90
3	Double disc press drill	24.1	14.96
4	Double disc press drill-extra tillage	24.2	21.18

The highest net yield and return was achieved on plot #1 (hoe press drill) where there was an 8 bu/ac advantage over the other treatments. The extra spring tillage operation on the double disc press drill did not produce a yield advantage over plot #3, but did produce a better grade thereby improving the net return per acre.

1989: The Canora site was discontinued in the spring of 1989, therefore disallowing adequate time to establish a new site.

2.5 EXTENSION DISTRICT #20 - WYNYARD

OBJECTIVES: Three different seeding systems are being compared in a minimum tillage extended crop rotation. This site had been continuously cropped for several years. The only tillage operation is a fall fertilizer banding treatment. The three systems (airseeder, hoe press drill, and discer) are being compared to determine variations in trash clearance and penetration, crop emergence and crop yield.

RESULTS:

1986: In the fall of 1985, 100 lbs/ac of 46-0-0 was banded. A preseeding application of Roundup at 1.0 L/ac was done. 30 lbs/ac of phosphate was seedplaced on each of the treatments.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Airseeder	53.5	51.66
2	Hoe press drills	53.1	50.56
3	Discers	48.8	41.18

Plots #1 and #2 produced similar yields and net returns. Some of the yield differences in the site may be attributed to variations in the ability of the various implements to control weeds at the time of seeding and their packing ability. The discer had some difficulty cutting the heavy trash (65 bu/ac wheat crop residue). This may have affected the accuracy of seed placement.

1987: The original layout of plots remained the same in 1987, however an adjacent Maximum Economic Yield (MEY) plot studied minimum tillage fertilization; comparing nitrogen only to nitrogen and phosphorus combined. The objective is to determine the most efficient method of investing $15/acre in fertilizer. Treatments on plots #1, 2, and 3 remain basically the same with the exception of one more harrowing operation in 1987.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Airseeder	40.9	21.81
2	Morris MH310 Hoe press drill	39.3	17.37
3	Discers	38.6	12.74
4	Haybuster Hoe drill; N only	31.2	----
5	Haybuster Hoe drill; N and P	34.0	----

As in 1986, the highest yield was produced on plot #1, followed by plot #2 and #3. The co-operator observed that germination on

plot #3 was uneven. This is confirmed by the CGC report which indicates that plot #3 had not reached the same level of maturity as plots #1 and #2 on the harvest date. The adjacent MEY fertilizer study (plots #4 and #5) indicate that plot #5 where nitrogen and phosphorus were used together, outyielded plot #4 where only nitrogen was applied.

1988: In the fall of 1987, all plots were deepbanded with 125 lbs/ac of 35-15-0. In the spring, an additional 50 lbs of fertilizer was seedplaced in the form of 9-18-0-20 on all three plots. Each plot was pre-worked once with a heavy duty cultivator and harrowed once after seeding. Also, in the fall of 1987, Rival 10G was incorporated at 12.5 lbs/ac and a spot treatment with Roundup was done on all plots.

Crop: Tilney mustard

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Airseeder	13.60	21.49
2	Hoe press drill	8.60	-21.90
3	Discers	11.70	8.18

The highest yield and net return were achieved on plot #1, where an airseeder was used. Plot #2 produced the lowest yield and net return. This is probably attributable to problems with the hoe drill that led to overfertilization. The resulting high levels of seed placed nitrogen may have had a negative effect on yield. All three treatments germinated uniformly. Maturity on plot #2 was delayed relative to plots #1 and #3. This collaborates the observation that overfertilization may have had a direct effect on the yield of plot #2.

1989: In the fall of 1988, Roundup was applied at 1.0 L/ac followed by 2,4-D at 7 oz. active ingredient per acre. There was no preseeding tillage.

Crop: Harrington barley

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Airseeder	25.4	- 7.47
2	Hoe press drill	28.4	- 1.42
3	Discers	22.1	-12.51

The highest yield and net return were achieved on Plot #2, the hoe press drill treatment. Given the dry conditions that prevailed at seeding time and the moisture stress throughout the growing season, it is probably that the yield advantage of the hoe drill is due to precise seed placement and excellent packing capabilities.

2.6 EXTENSION DISTRICT #39 - FORT QU'APPELLE

OBJECTIVES: This site compares the economic and agronomic feasibility of three different cropping rotations: continuous, 50/50 crop.fallow, and 2/3:1/3 crop:crop:fallow. The effects of fall tillage and snow trapping have been superimposed across the various treatments to monitor their influence on crop yield.

RESULTS:

1986: Plots #1 to #4 were all cropped in 1986 with plots #5 and #6 in fallow. The three crop rotations have been replicated to avoid the confounding effects of field location and/or a poor growing season. No yield differences were observed across the cropped treatments in 1986 which was the establishment year for the site. An unfertilized strip was left as a control to compare differences between it and the plots fertilized at 120 lbs/ac of 46-0-0. All of the plots that were cropped had 60 lbs/ac 11-51-0 seedplaced.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1, 2, 3	Springbanded 120 lbs/ac (46-0-0)	36.8	14.77
4	No nitrogen fertilizer	24.6	6.17
5, 6	Fallow treatments	----	-20.22

The yield of the unfertilized strip (plot #4) reflects the low nutrient application. The cost of summerfallowing plots #5 and #6 is included for interest sake. This cost reflects six passes with the cultivator at $3.32/ac/pass.

1987: In the fall of 1986, half of each plot from #1 to #4 was tandem disced and then cultivated. The other half did not receive any tillage. Plots #1 and #2 were deepbanded in the spring and then seeded. Plots #5 and #6 had 50 lbs/ac seedplaced as 11-55-0.

Crop: Neepawa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Continuous cropping/ disced	17.2	-44.69
	Continuous cropping; not disced	19.3	-31.25
2	2/3:1/3; disced	13.4	-53.77
	2/3:1/3; not disced	15.7	-39.86
3 & 4	Fallow treatments (2/3:1/3;1/2:1/2)	----	----
5	2/3:1/3	40.0	17.78
6	1/2:1/2; normal treatment	40.0	17.78

Plots #5 and #6, which were fallowed in 1986 produced the highest yield, the highest bushel weight and had less dockage than the other treatments. The tandem disced portion of the treatments produced lower yields than the remainder of the treatment where trash was retained for snow trapping. The variation may have been more pronounced if there had been adequate soil moisture recharge from snowfall precipitation.

1988: The 1987 fallow plots (#3 and #4) were worked four times each with a heavy duty cultivator and twice each with a roadweeder. The fall tillage treatments included one pass with a heavy duty cultivator over plots #1, 2, 5 and 6. In 1988, plots #1 and #5 were spring banded with 100 lbs/ac of 46-0-0. 50 lbs/ac of 12-51-0 was seedplaced in plots #1, 3, 4 and 5.

Crop: Neepawa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Continuous cropping; banded	4.2	-60.01
	Continuous cropping; no nitrogen	3.5	-42.35
2	Fallow treatment (2/3:1/3)	----	----
3	2/3:1/3; seedplaced P O	12.5	-23.46
	2/3:1/3; no P O	14.6	- 7.60
4	1/2:1/2; no nitrogen	12.5	-23.46
	1/2:1/2; banded	16.1	-38.50
5	2/3:1/3; banded	14.30	-21.20
6	Fallow treatment (1/2:1/2)	----	----

None of the treatments produced a positive net return due to the extreme drought and heat stress conditions predominant in 1988. Fallow treatments (plots #3 and #4) yielded only 12.5 bu/ac despite excellent spring nutrient status. There was very little soil moisture recharge due to the lack of snow cover. This field received less than 2 inches of rainfall during the 1988 growing season.

1989: In October of 1988 half of treatments #1-#3 and all of plot #6 were treated with Rival 10G at 5.7 kg/ac. The other half of each treatment was sprayed with a post emergent rank mix of Poast and Buctril M. Plots #4 and #5 were worked 4 times with a heavy duty cultivator over the fallow season. All of plots #1 and #3 received 50 lbs/ac of 27-27-0 and all of plots #2 and #6 received 30 lbs/ac of 11-51-0. Plots #1-#4 and #6 received two tillage treatments in total prior to seeding and all plots were seeded with an airseeder.

Crop: Norlin flax

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Continuous cropping;post-emergent	6.9	- 6.95
	Continuous cropping; pre-emergent	3.9	-34.52
2	2/3:1/3; post-emergent	9.3	- 0.36
	2/3:1/3; pre-emergent	6.2	-28.63
3	2/3:1/3; post-emergent	5.6	-17.35
	2/3:1/3; pre-emergent	7.9	- 2.72
4 & 5	Fallow treatments (1/2:1/2:2/3:1/3)	----	-13.48
6	1/2:1/2; pre-emergent	13.1	26.17

Plots #2 and #6, which were fallow in 1988, produced the only positive returns. The seedbed conditions were very dry at seeding time and germination was poor. The comparison between post and pre-emergent herbicides tends to lean towards better overall results from the post-emergent treatments. The combined net return for the post-emergent and pre-emergent treatments for plots #1-#3 are #3.81 and $-34.75 respectively. Wild oat control was inadequate with the pre-emergent treatment while control was good in the post-emergent treatments. The fallow treatment costs are noted for discussion purposes only.

2.7 EXTENSION DISTRICT #42 - KELVINGTON

OBJECTIVES: This project studies three different seeding implements and the tillage practices required by each to produce a suitable seedbed while providing adequate erosion protection. The three systems are: double disc press drill, seedrite and airseeder.

RESULTS:

1986: A pre-emergent herbicide was incorporated followed by a 50 lb/ac application of 11-51-0 seedplaced. Fallow costs from 1985 were carried over to 1986 expenses. All plots received four tillage treatments in the fallow year and three spring tillage treatments before the seeding operations. All plots were harrowed post seeding.

Crop: Westar canola

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Airseeder	24.7	55.05
2	Double disc press drill	28.7	76.24
3	Seedrite	28.5	75.07

Given the poor moisture conditions at seeding, some of the yield difference may be attributed to the superior packing job done by the seedrite and double disc press drill.

1987: In 1987, a minimum tillage seedplaced fertilizer treatment was added to this site. 46 lbs/ac N and 23 lbs/ac P were seedplaced as 26-13-0 on plot #1. Plots #2, 3, and 4 received 41 lbs/ac N spring banded as 46-0-0 and 23 lbs/ac P seedplaced as 11-

55-0. All plots were cultivated and harrowed once in the fall of 1986 and harrowed once after seeding.

Crop: Harrington barley

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Minimum till 26-13-0 seedplaced	55.9	89.86
2	Airseeder	41.8	41.89
3	Morris M-10 double disc press drill	45.4	52.76
4	Seedrite	44.4	48.65

Plot #1, where 26-13-0 was seedplaced at 175 lb/ac with no prior spring tillage, produced the highest yield. This may be attributable to moisture retained by not cultivating the soil in the spring to apply ntirogen fertilizer. Plot #3, the press drill treatment, produced the highest yield amongst the treatments that were spring banded. This may be attributable to the packing capabilities of the double disc press drill.

1988: Fall tillage on all plots in 1987 included one pass with a heavy duty cultivator and one pass with the harrows. Plots #2, #3 and #4 were spring banded with 90 lb/ac of 46-0-0 and received 50 lbs/ac of 12-51-0 seedplaced. Plot #1 had 180 lbs/ac of 26-13-0 seedplaced.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Minimum till; 26-13-0 seedplaced	18.6	8.36
2	Airseeder	16.6	-3.04
3	Double disc press drill	18.0	2.52
4	Seedrite	15.6	-7.00

The highest yield and net return was achieved on plot #1, the minimum tillage treatment involving seed placed fertilizer. The yields of all the treatments were adversely affected by the heat and drought stress conditions predominant in 1988.

1989: Spring and fall tillage and fertilizer treatments from 1988 were identical to 1989, however fertilizer rates were reduced somewhat.

Crop: Norlin flax

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	Minimum till; 26-13-0 seedplaced	13.2	49.78
2	Airseeder	11.8	30.79
3	Double disc press drill	9.6	13.36
4	Seedrite	10.4	19.65

The highest yield and net return was again achieved by the seedplaced fertilizer/airseeder plot. The heat stress which affected the crop in mid-summer had adverse effects on yield. The improved yield of the minimum tillage system may be attributed to the moisture conserved from reduced tillage.

2.8 EXTENSION DISTRICT #43 - WATROUS

OBJECTIVES: This project examines the economic and agronomic feasibility of two crop rotations common in the district; continuous cropping and 2/3:1/3 crop:crop:fallow.

RESULTS:

1986: No yield difference was observed across the treatments in 1986. The rotations have been replicated to avoid the confounding effects of field location and/or a poor growing season. The average yield across the entire treatment was 19.5 bu/ac with a net return of $-16.48/acre.

1987: 46 lbs/ac of N was broadcast and incorporated as 46-0-0 on plots #3 and #4 and 40 lbs of P was seedplaced as 11-55-0 on plots #1, 3 and 4. Plots #3 and #4 were worked once in the 1986 fall season. Plot #1 was pre-worked with a vibrachisel and plots #1, 3 and 4 were harrowed once after seeding.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	2/3:1/3	32.5	31.75
2	2/3:1/3 fallow	----	----
3	2/3:1/3	28.1	12.38
4	Continuous cropping	26.6	8.44

Plot #1, which was fallow in 1986, produced the highest yield. This may be attributable to moisture retention during the fallow year.

1988: Fertilization and tillage were similar between 1987 and 1988 with the exception of slightly increased fertilizer rates.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	2/3:1/3	16.6	2.06
2	2/3:1/3	25.6	31.68
3	2/3:1/3 fallow	----	----
4	Continuous cropping	7.1	-42.14

The highest yield and net return was achieved on plot #2, 2/3:1/3 rotation on fallow. Plot #1, 2/3:1/3 rotation on stubble (second crop) also produced a positive net return. Plot #4, continuous cropping produced the lowest net yield and a negative net return. Hot, dry, windy conditions reduced tillering and affected net yields. Growing season precipitation was approximately 5.3 inches.

1989: Liquid fertilizer was incorporated at 43.87 lbs/ac in the form of 10-34-0. A harrow-packer drawbar was used on the #4 treatment prior to seeding and on all treatments after seeding.

Crop: Katepwa wheat

Plot #	Plot Description	Yield bu/acre	Net Return $/acre
1	2/3:1/3 fallow	----	-35.68
2	2/3:1/3	17.9	20.20
3	2/3:1/3	23.8	15.30
4	Continuous cropping	18.7	- 9.43

The highest yield and net return in 1989 was once again on fallow (plot #3). This may be attributable to moisture retention during the fallow year. The continuous cropping treatment produced the lowest net return. The total expenses per acre for plot #4 were $78.10 as compared to $45.47 incurred by treatments #2 and #3. Growing season precipitation was approximately 6.0 inches.

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